

MEMORANDUM OF UNDERSTANDING

between

**JEFFERSON SCIENCE ASSOCIATES, LLC.,
THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY**

and

ARTEM ALIKHANIAN NATIONAL LABORATORY

Jefferson Science Associates, LLC, the management and operating contractor of the Thomas Jefferson National Accelerator Facility (JSA/Jefferson Lab), for the United States Department of Energy, under U.S. DOE Contract No. DE-AC05-06OR23177 located at 12000 Jefferson Avenue, Newport News, Virginia 23606, and Artem Alikhanian National Laboratory (AANL), 02 Alikhanian Brothers Str., 0036 Yerevan, Armenia, collectively herein the “Participants”,

SHARING an interest in collaborating to advance nuclear physics using the 12 GeV Upgrade facility at Jefferson Lab,

HAVE REACHED THE FOLLOWING UNDERSTANDING:

I. OBJECTIVE

1. The Participants intend to work together to develop key components of the Hall B CLAS12 spectrometer as part of the 12 GeV CEBAF Upgrade Project. The pre-shower calorimeter (PCAL) and high threshold Cerenkov counter (HTCC) are important components of the particle identification system of the CLAS12 detector.
2. The entities expected to collaborate in the activities under this Memorandum of Understanding (MOU) include:
 1. JSA is a Southeastern Universities Research Association/ Computer Sciences Corporation, limited liability company created specifically to manage and operate Jefferson Lab. The DOE Office of Nuclear Physics within the Office of Science operates the Continuous Electron Beam Accelerator Facility (CEBAF) as a national user facility at Jefferson Lab.

CEBAF is a world-leading facility in the experimental study of hadronic matter. The 12 GeV CEBAF Upgrade directly addresses a major scientific opportunity identified in both the 2002 and the 2007 Long Range Plans in which the Nuclear Science Advisory Committee of the U.S. Department of Energy and the U.S. National Science Foundation recommends the 12 GeV CEBAF Upgrade as one of its highest priorities for the program of the Office of Science's Office of Nuclear Physics. The full scope of the 12 GeV CEBAF Upgrade project includes upgrading the electron energy of the main accelerator from 6 GeV (billion electron volts) to 12 GeV, constructing a new experimental area (Hall D), and enhancing the capabilities in the existing experimental halls. Construction started in 2009 and the start of commissioning is scheduled for 2014.

2. AANL was a principal participant, in the design, construction and commissioning of the present CLAS Forward Electromagnetic Calorimeter in Hall B. To support the CLAS12 upgrade, the AANL group is expected to provide a substantial contribution to the building and commissioning of the PCAL and HTCC as well as development of software for operation and control of detector components.

II. PLANNED AREAS OF COOPERATION

Proposed collaboration may include, but is not limited to, the following:

1. AANL:

- a) Participate as a member of the Hall B Collaboration,
- b) Participate in the construction of the Hall B experimental equipment, specifically, the development of the CLAS12 PCAL and HTCC,
- c) Develop software for monitoring and control of experimental equipment,
- d) Provide regular updates on progress and schedule to the Hall B 12 GeV Assistant Project Manager, and
- e) Participate as necessary in related 12 GeV Upgrade project reviews.

2. JSA/Jefferson Lab:

- a) Provide an appropriate on-site work environment including space, computer access, necessary training and other resources as required for all user scientists,
- b) Anticipates providing some travel support for AANL personnel while working at Jefferson Lab. Any such support is to be implemented under a separate agreement,
- c) Provide a sufficiently detailed Statement of Work describing the goals and expectations,
- d) Keep key AANL personnel informed of overall project status and requirements for the joint scope of work, and
- e) Develop and provide the forum for regular progress updates by the AANL personnel.

Other collaborative activities may be added by the Participants' mutual consent in writing.

III. FORMS OF COOPERATION

Cooperation may include, but is not limited to:

1. Exchange of information, publications, reports, and technical data;
2. Exchange of scientists, engineers, students, and other specialists for participation in project activities. Each Participant is to abide by the health, safety, and environmental requirements of the host Participant when on an exchange assignment at the host Participant's facility.

IV. MECHANISMS OF COOPERATION

A. KEY PERSONNEL

1. The spokesperson for 12 GeV participants of AANL is Dr. N. Dashyan (AANL Staff Scientist). It is anticipated that the collaborative effort contributed to the construction will include up to 2.0 fulltime equivalents FTEs of staff scientists, 1.5 FTE of a junior scientist, 0.5 FTE of an engineer, and two PhD students.

The time commitment of members of the research group of AANL in the 12 GeV construction efforts described in this MOU is anticipated to be as follows:

| Name | Position | 2012 (FTE) | 2013 (FTE) | 2014 (FTE) |
|---------------------|------------------|---------------|---------------|---------------|
| Natalya Dashyan | Staff scientist | 0.5 | 0.5 | 0.5 |
| Gegham Asryan | Staff scientist | 0.5 | 0.5 | 0.5 |
| Hakob Voskanyan | Staff scientist | 0.5 | 0.5 | 0.5 |
| Nerses Gevorgyan | Staff scientist | 0.5 | 0.5 | 0.5 |
| Samvel Mailyan | Engineer | 0.5 | 0.5 | 0.5 |
| Ani Simonyan | Junior scientist | 0.5 | 0.5 | 0.5 |
| Yeranuhi Ghandilyan | Junior scientist | 0.5 | 0.5 | 0.5 |
| TBD | Grad. student | 0.5 | 0.5 | 0.5 |
| TBD | Grad. student | 0.5 | 0.5 | 0.5 |

NOTE: FTE in the above table represents the fractional fulltime equivalent.

2. Key personnel from Jefferson Lab include: Dr. L. Elouadrhiri (Assistant Project Manager for the Hall B 12 GeV Upgrade) and Dr. S. Stepanyan

(Jefferson Lab Staff Scientist). Dr. Elouadrhiri will act as the liaison and primary point of contact for this collaboration.

V. GENERAL CONSIDERATIONS

1. This MOU does not create any legally binding obligations between or among the Participants. If commitment, obligation, or transfer of funds is required, a specific contractual agreement, or other reimbursable arrangement is to be developed between JSA/Jefferson Lab and the participating organization to provide specific funding, obligation, and billing data.
2. The conduct of cooperative activities contemplated by this MOU is subject to the availability of funding, personnel, and other resources.
3. Each Participant should conduct the cooperation under this MOU in accordance with applicable laws and regulations to which it is subject, including export control laws and regulations, and international agreements to which its Government is party.
4. Each Participant is responsible for the costs it incurs in participating in cooperative activities under this MOU, except as provided in Section II.
5. Any transfer or loan of equipment is to be implemented under a separate agreement.
6. The Participants intend to acknowledge in publications all institutions that contribute to results achieved from activities conducted under this MOU and in the manner customary for scholarly publication. Each Participant intends to utilize its institutions' review procedures for all publications (to include presentations) developed under this MOU.

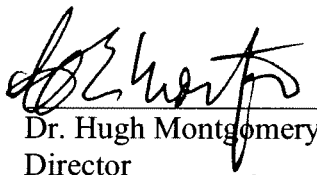
VI. COMMENCEMENT, MODIFICATION AND DISCONTINUATION

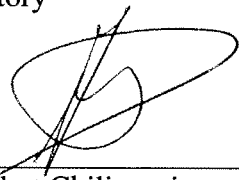
- I. Cooperative activities under this MOU may commence upon signature by the Participants and continue for a 5-year period unless discontinued in accordance with paragraph 2 of this Section VI.
- II. The Participants may discontinue this MOU at any time in writing. A Participant that wishes to discontinue its participation in this MOU should endeavor to provide at least ninety (90) days written notice to the other Participants.
- III. This MOU may be modified in writing by the mutual consent of the Participants, and may be extended for additional periods.


Signed in duplicate.

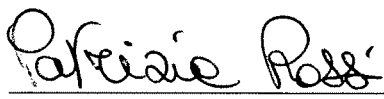
Jefferson Lab

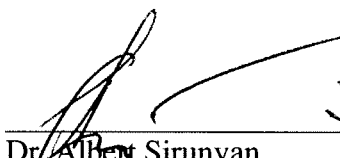
Artem Alikhanian National
Laboratory

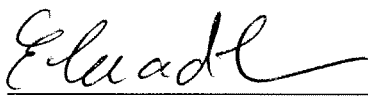
 8/20/2012
Dr. Hugh Montgomery Date
Director

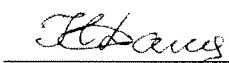
 2.08.2012
Dr. Ashot Chilingarian Date
Director

 8/15/2012
Claus Rode Date
12 GeV Upgrade Project Manager

 8/15/2012
Dr. Rolf Ent Date
Associate Director for Physics

 3.08.2012
Dr. Albert Sirunyan Date
Head of Experimental Physics Division

 8/13/12
Dr. Latifa Elouadrhiri Date
Assistant Project Manager for the
Hall B Upgrade

 3.08.2012
Dr. Natalya Dashyan Date
Spokesperson